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10/803,342

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EXAMINER

ALANKO, ANITA KAREN

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

| | | | |
|------------------------------|--------------------------------------|---|--|
| Office Action Summary | Application No. 10/803,342 | Applicant(s) KOEMTZOPOULOS ET AL. | |
| | Examiner Anita K. Alanko | Art Unit 1792 | |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 2/24/09 - RCE.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,4-8,10-16,18 and 19 is/are pending in the application.
- 4a) Of the above claim(s) 15 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,4-8,10-16,18 and 19 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>2/24/09</u> . | 6) <input type="checkbox"/> Other: _____ |

Continued Examination Under 37 CFR 1.114

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 2/24/09 has been entered.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

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Claims 1, 4-8, 10-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chantre et al (US 2001/0051413 A1) in view of Vallon et al (JVST A 1997), Chen (EP 0200951 A2), Brown et al (US 2003/0186492 A1) and Yang et al (US 6,451,647 B1).

Chantre discloses a method of etching a stack (Fig.2a-2e) with at least one silicon germanium layer 3 [0018] over a substrate 1 [0017] in a processing chamber and a polysilicon layer 4 [0018] over the silicon germanium layer, wherein at least one region of the polysilicon layer is doped [0018], comprising:

providing a silicon germanium etch ([0019], Fig.2c); and

providing a break through etch of the polysilicon layer over the silicon germanium layer, wherein at least one region of the polysilicon layer is doped, comprising:

providing an etchant gas into the processing chamber and transforming the etching gas to a plasma to etch the polysilicon layer (“anisotropic dry plasma etching”, [0018], Fig.2b).

However, Chantre fails to disclose the etchants for the various layers.

Brown teaches that in methods of simultaneously etching stacks with doped and undoped regions, that it is useful to etch polysilicon with doped and undoped regions with an etch optimized to provide vertical profiles (by passivation layer 50 on the sidewalls, [0037]), and then to use another etching process for the remainder of the polysilicon 30 ([0038]). It would have thus been obvious to use different etchants for such as a break-through and main etch in the method of Chantre because Brown teaches that this is a useful technique for optimizing the anisotropic etching process of polysilicon layers with doped and undoped regions.

Break-through etch of doped and undoped regions

Chen teaches that an etchant gas of N_2 , SF_6 and CHF_3 is useful for etching silicon at high rates and anisotropy (see abstract, col.4, lines 1-14). The etchant is useful for both doped and undoped layers (col.3, lines 51-56).

It would have been obvious to one with ordinary skill in the art to break-through etch the doped and undoped regions of silicon with N_2 , SF_6 and CHF_3 in the modified method of Chantre because Chen teaches that it is a useful composition for etching doped and undoped silicon.

Polysilicon main etch after the break-through etch

Yang teaches that silicon may be etched with Cl_2 , HBr , CF_4 and O_2 (col.11, lines 20-22, 32-33; col.14, lines 7-10).

It would have been obvious to main etch silicon with Cl_2 , HBr , CF_4 and O_2 in the modified method of Chantre because Yang teaches it is a useful etching composition for silicon.

SiGe etch

Vallon discloses a method for etching a stack (Fig.1) with at least one SiGe layer (see Fig.1) over a substrate (silicon substrate, Fig.1) in a processing chamber, comprising providing a silicon germanium etch, comprising:

providing an etchant gas into the processing chamber, wherein the etchant gas comprises HBr , an inert diluent (helium) and O_2 (page 1875, col.2, lines 2-3);

cooling the substrate to a temperature below $40\text{ }^{\circ}C$ ($25\text{ }^{\circ}C$, page 1875, col.2, line 2); and

transforming the etching gas to a plasma to etch the silicon germanium layer (page 1876, section III.A.)

It would have been obvious to etch the SiGe layer with HBr, an inert diluent (helium) and O₂ and to cool the substrate to a temperature below 40 °C in the method of Chantre because Vallon teaches that this is useful for patterning SiGe.

Thus, as to amended claim 1, Vallon, Chen and Yang all teach compositions for etching the layers cited in modified Chantre that need to be etched. All of the etching compositions perform their same function of etching as they did separately. One of ordinary skill in the art would have recognized that the results of the combination were predictable, that of etching to form a patterned structure. Therefore, all the claimed elements were known in the prior art and one skilled in the art could have combined the elements as claimed by known methods with no change in their respective functions, and the combination would have yielded predictable results to one of ordinary skill in the art at the time of the invention.

As to claim 4, since the modified method of Chantre is the same as the instant invention, the same results are expected.

As to claims 5-6, it would have been obvious to form a seed layer in the modified method of Chantre in order to improve the deposition of the SiGe layer because seed layers are conventional. The cited thicknesses are expected to be within the scope of one skilled in the art.

As to claims 7-8, Chantre discloses to use a mask [0018], but fails to disclose the type of mask. It would have been obvious to one with ordinary skill in the art to use the photoresist as

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cited in the method of Bu because it is a conventional photoresist and is expected to yield the predictable result of enabling patterning of the stack.

As to claim 10, it would have been obvious to vary the thickness to that cited in order to optimize the final product for best results.

As to claims 11-14, see the rejection of claims 5-8.

Claims 16 and 18-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Brown et al (US 2003/0186492 A1) in view of Chen (EP 0200951 A2) and Yang et al (US 6,451,647 B1).

Brown discloses a method of simultaneously etching stacks with doped and undoped regions ([0012]-[0013] P-doped may be undoped), that it is useful to etch polysilicon with doped and undoped regions with an etch optimized to provide vertical profiles (by passivation layer 50 on the sidewalls, [0037]), and then to use another etching process for the remainder of the polysilicon 30 ([0038]).

Brown fails to disclose the cited etchants.

Etch of doped and undoped regions

Chen teaches that an etchant gas of N₂, SF₆ and CHF₃ is useful for etching silicon at high rates and anisotropy (see abstract, col.4, lines 1-14). The etchant is useful for both doped and undoped layers (col.3, lines 51-56).

Polysilicon main etch after the break-through etch

Yang teaches that silicon may be etched with Cl₂, HBr, CF₄ and O₂ (col.11, lines 20-22, 32-33; col.14, lines 7-10).

It would have been obvious to etch polysilicon, comprising both doped and undoped regions as taught by Chen and then to main etch polysilicon as taught by Yang, in the method of Brown because Chen and Yang teach useful etchants to provide vertical profiles in the polysilicon.

As to claim 18, Brown discloses to use a hard mask [0007]. However it would have been obvious to use a photoresist to pattern the hard mask because it is a conventional technique to use a photoresist to pattern to provide hard mask layers.

As to claim 19, It would have been obvious to one with ordinary skill in the art to use the 193 or higher generation photoresist as cited in the method of Brown because it is a conventional photoresist and is expected to yield the predictable result of enabling patterning of the stack.

Response to Amendment

Claims 1, 4-8, 10-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chantre et al (US 2001/0051413 A1) in view of Vallon et al (JVST A 1997), Chen (EP 0200951 A2), Brown et al (US 2003/0186492 A1) and Yang et al (US 6,451,647 B1). Brown and Yang

are newly relied upon to teach the new claim 1 limitations of a main etch after a break through etch, and the etchants for the separate etch steps.

Claims 16 and 18-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Brown et al (US 2003/0186492 A1) in view of Chen (EP 0200951 A2) and Yang et al (US 6,451,647 B1). Brown is newly relied upon to teach the base method, with Chen and Yang used to teach the different etchants.

Response to Arguments

Applicant's arguments with respect to claims 1, 4-8, 10-14, 16 and 18-19 have been considered but are moot in view of the new ground(s) of rejection. Brown is newly cited to teach etching of doped and undoped polysilicon layers with different etchants.

Applicant argues that Chen fails to teach simultaneous etching of doped and undoped regions. In response, upon further consideration of Chen, Chen does indeed etching of doped and undoped regions (last paragraph of col.3), and when combined with modified Chantre renders the claimed invention obvious. Chen teaches an advantage of the etchant not attacking the sidewall of differently doped polysilicon, with minimum under-cut (col.2, lines 34-39).

Examiner acknowledges that the references don't teach a separate break-through etch. Brown is newly cited to teach this limitation.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Andriacos is cited to teach lowering substrates temperatures during silicon or SiGe

etching [0012], with concomitant increase in selectivity to the silicon oxide mask and more vertical profiles [0034].

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Anita K. Alanko whose telephone number is 571-272-1458. The examiner can normally be reached on Mon-Fri until 3:30 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on 571-272-1465. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Anita K Alanko/
Primary Examiner, Art Unit 1792